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1996-97 School Year

Chemistry 30 Information Bulletin

Diploma Examinations Program

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Parents	
General Audience	
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Purpose of the Bulletin

The purpose of this bulletin is to provide students and teachers of Chemistry 30 with information about the diploma examinations scheduled for 1997.

We encourage teachers to share the contents of this bulletin with students and to review the scoring criteria with them.

If you have requests, questions, or comments about the contents of this bulletin, please contact:

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Important Dates in 1997

Administration of the Chemistry 30 Diploma Examination

1997 Administrations	*Time**
Thursday, January 30	9:00–11:30 A.M.
Friday, June 27	9:00–11:30 A.M.
Thursday, August 14	1:00–3:30 P.M.

* The diploma examination is designed for a writing time of 2.5 h. Students may have an additional 0.5 h to complete the examination.

Please consult the *General Information Bulletin, Diploma Examinations Program*, for a complete schedule for all subject areas.

Scoring of the Examination

1997 Administrations	*Scoring Dates***
January	February 12 (Head Markers) February 13 to 15
June	July 6 (Head Markers) July 7 to 10
August	August 22

** Dates are tentative and will be confirmed by telephone with markers.

Notes of Interest

Information about Markers

The written-response questions of the Chemistry 30 Diploma Examinations are marked by Chemistry 30 teachers selected from those who have been recommended as markers to the Student Evaluation Branch by their superintendents. To qualify for recommendation, a teacher must have taught the complete Chemistry 30 course twice, be teaching the course in the current school year, and have a valid Alberta or Northwest Territories Permanent Professional Teaching Certificate.

Often, more teachers are recommended as markers by superintendents than are required by the Student Evaluation Branch for any one marking session. The following criteria are considered when markers are selected for a particular marking session:

- experienced markers and first time markers are included
- regional representation (by zone, jurisdiction, and school)
- student population (proportional representation)

We particularly need teachers who can mark examinations written in French.

Teachers who wish to be recommended as markers for the January 1997 examination should contact their superintendents by September 27, 1996. Teachers who wish to be recommended as markers for the June and August 1996 examinations should contact their superintendents by **February 28, 1997**.

Field Testing and Item Writing

As the need arises for teachers to participate in field testing and item writing, letters are sent to superintendents requesting their nominations. **Teachers who are interested in these activities should let their superintendents know by September 12, 1996**.

Reports

After each January and June administration of the Chemistry 30 diploma examination, copies of the *Examiners' Report* for that particular administration are sent to teachers in all senior high schools in Alberta. The report contains provincial results along with comments about student performance on the examination.

Examiners' reports are designed for teacher use. If we can make these reports more useful to you, please let us know.

School and Jurisdiction Statistical Reports are sent to each superintendent and senior high school principal after each January and June administration of the Chemistry 30 diploma examination. These reports provide detailed information on how well the students in their school district and school, respectively, did on the Chemistry 30 diploma examination. Teachers may use these data to reflect on the areas of the program where their students did well and those areas where student performance was poor.

Each year, the Student Evaluation Branch produces the *Annual Report, Diploma Examinations Program.* This report contains information about the results achieved by all students who wrote diploma examinations in the preceding school year. It also contains special studies on topics of interest. The first annual report (1989–90 school year) contains a study comparing achievement in various diploma courses. The second report (1990–91 school year) contains a study comparing the achievement of students who repeat diploma examination courses and rewrite diploma examinations with their achievement the first time and with the achievement of students who write only once. The third report (1991–92 school year) contains a study of participation rates in diploma examination courses. The fourth report (1992–93 school year) contains a study of English 30 students' application of conventions of language. The fifth report (1993–94 school year) presents a comparison of provincial participation rates in diploma examination subjects for the school years 1991–92, 1992–93, and 1993–94. The sixth report (1994–95 school year) examines declining enrollment of Grade 12 students. Each of these special studies will be of interest to teachers who are involved in interpreting diploma examinations results of their students.

Additional copies are available from the student Evaluation Branch. Phone: 427-0010 FAX: 403-422-4200
To call toll-free from outside of Edmonton, dial 310-000.

As of the 1995-96 school year, this report is available on the Internet at Alberta Education's Web Site (http://ednet.edu.gov.ab.ca).

Inservices and Presentations

On a limited basis and subject to budget constraints, Student Evaluation Branch staff is available to provide inservices or presentations related to diploma examinations or the interpretation of diploma examination results.

Student Use of Scientific Calculators

Examinations are constructed to ensure that the use of particular scientific calculators neither advantages nor disadvantages individual students. Students are expected to provide their own scientific calculators. For a chemistry examination, all that is needed is a calculator capable of performing logarithmetic calculations.

Refer to Appendix A for the policy statement on the use of scientific calculators on diploma examinations. Students should be made aware of this policy as early as possible in the school term to ensure they are able to use the scientific calculator of their choice when writing examinations.

Clarification

Students should also be made aware of the Examination Rules, Grade 12 Diploma Examinations, in the *General Information Bulletin*. Students should know that notes stored in electronic devices may not be brought into the examination room. It is the student's responsibility to ensure there is no information stored in the calculator. Failure to do this is a breach of exam procedures and is considered cheating.

Data Resources

The Chemistry 30 diploma examinations require the use of a separate data booklet. There are no changes to the data booklet for the 1996–97 school year.

Guide for Students

New

A publication written for students called *Students First: A Guide for Students Preparing to Write the Chemistry 30 Diploma Examination* is available in each senior high school. See your principal or department head for the black line master. This publication contains suggestions for exam preparation and exam writing suggestions. The Student Evaluation Branch highly recommends that students and teachers examine this document early in the term to prepare for the Chemistry 30 Examination. Parents will also find this to be a useful publication.

Student Requests for Rescores

Students may request a rescoring of their diploma examinations. Before applying for a rescoring, students should check their Diploma Examination Results Statement to find out the distribution of marks. The mark on the machine-scored questions is not likely to change as a result of a rescore, but the written-response mark could change slightly. Students should remember that the rescored mark will be the final mark whether it *increases* or *decreases*.

Students who decide to have an examinaton rescored must ensure that their application is received before the deadline specified on the results statement. The fee for rescoring each examination is $26.75, which includes GST. If a diploma examination mark is increased by 5% or more as a result of rescoring, the fee is refunded.

Student Requests for Rewriting

Students may rewrite a diploma examination at any regularly scheduled administration. Students must apply to the Student Evaluation Branch by November 15, 1996, and April 15, 1997, to be eligible to write the January and June diploma examinations. The fee for rewriting each examination is $26.75, which includes GST. (For more details, see the *General Informaton Bulletin.*)

Chemistry 30 Information

Objectives of the Course

Chemistry 30 is intended for students who want to better understand the chemistry principles behind the natural events they experience and the technology they use in their daily lives. Chemistry 30 is an experimental discipline requiring creativity and imagination. The course is designed for students who are preparing for academic post-secondary studies.

Students of Chemistry 30 have developed their aptitude for observing, collecting facts, forming generalizations, hypothesizing, and making inferences from observations. They have shown growth in their understanding of chemical concepts, their increased ability to apply these concepts to relevant situations, and their ability to communicate in the specialized language of chemistry.

This growth and development in students has taken place as a result of general education and cognitive maturation. It has been enhanced by science courses, and in particular by the successful completion of Science 10 and Chemistry 20. These courses develop knowledge and skills that are prerequiste to success in Chemistry 30.

Standards

Students who achieve an *acceptable* standard of performance in Chemistry 30 receive a final mark of 50% or higher. These students can demonstrate a basic understanding of the nature of scientific investigation by designing, observing, and interpreting simple laboratory tests. They can readily interpret data that are presented in simple graphs and tables, and can translate symbolic representations into word descriptions. They can readily recognize and provide definitions for key chemical terms. They can predict the physical and chemical properties of compounds. These students can demonstrate an acceptable level of understanding of chemical concepts by performing routine stoichiometric problems that do not involve multiple steps. They are capable of balancing an equation (combustion, formation, neutralization, or redox) and of solving the standard stoichiometric problems based upon these equations. Following the directions in laboratory procedures does not present a problem for these students, nor does using the data booklet to extract valid information. These students can compose clear and logical descriptive or explanatory statements to answer closed questions that do not involve more than one chemistry concept.

Students who achieve a standard of *excellence* in Chemistry 30 receive a final mark of 80% or higher. In addition to meeting the expectations for an acceptable standard of performance, these students demonstrate an interest in chemistry and feel confident about their abilities. They can readily interpret interrelated sets of data such as complex graphs and tables. When presenting scientific data, they select the most appropriate form. These students can analyze and evaluate experimental designs. They can create their own laboratory procedures when given a clear definition of a problem. They can recognize weaknesses in laboratory work and can find ways to correct the weaknesses. They can write their own equations for formation, combustion, neutralization, and redox reactions, and can solve many variations of stoichiometric problems based upon these equations, including equilibrium expressions. They are able to transfer what they see happening in a test tube into equation form and are able to express scientific ideas clearly. They can usually cope with problems that involve overlapping of two or more concepts. The most significant characteristic of this group is that they can solve problems of a new and unique nature and can extrapolate these solutions to higher levels of understanding. Open-ended questions are not a problem for them. These students can communicate clearly and concisely, using appropriate scientific vocabulary.

Examination Specifications

Each Chemistry 30 diploma examination is designed to reflect the *Chemistry 30 course* general learner expectations outlined in the *Chemistry 20–30 Program of Studies, Interim 1995, for Senior High Schools*. Each examination is built as closely as possible to these specifications. Small adjustments in emphasis may be necessary because the examination includes multimark written-response questions and/or machine-scored questions that cover more than one concept area. The concept areas are distributed proportionately over the examinations. Questions that require knowledge and skill in applying scientific processes are distributed throughout the examination but are not associated directly with specific topics; this is also true of the STS connections.

Knowledge ***Emphasis***

100%

The student can:

- apply conservation of matter and energy to changing systems; use evidence and knowledge to predict outcomes in a broad range of reactions (30%–40%)
- analyze and evaluate physical, chemical, and biological systems in terms of energy, matter forms, transfers, movement, and conservation (60%–70%)
- explain the relationships in physical, chemical, and nuclear changes through the rearrangement of bonds and the resulting release or absorption of energy (28%–32%)
- quantitatively and qualitatively explain and analyze the transfer of electrons and the associated transformations that take place in electrochemical systems (30%–34%)
- quantitatively and qualitatively describe equilibrium systems for acids, bases, and gases and some of their applications (16%–22%)
- quantitatively and qualitatively describe acids and bases in physical and conceptual terms (Brønsted-Lowry) (16%–22%)

Skills ***Emphasis***

40 to 60%

The student can:

- design, interpret, explain, analyze, and evaluate investigations
- organize data into tables, graphs, and diagrams and predict relationships
- interpret, explain, analyze, and evaluate data to infer relationships
- use appropriate scientific terminology and mathematical language to communicate and explain scientific concepts

Connections Among Science, Technology, and Society (STS) ***Emphasis***

40 to 60%

The student can:

- apply cause-and-effect reasoning to formulate relationships in which scientific evidence shapes or refutes a theory; and explain the limitations of science and technology in answering questions and solving problems
- describe and evaluate the design and function of technological solutions to theoretical and practical problems; and relate the ways in which science and technology advance one another
- evaluate from a variety of perspectives how science and technology are influenced and supported by society; assess the ability to interact responsibly with the environment
- apply the skills and knowledge acquired in science to everyday life

Some examination questions are organized into sets that relate to broad contexts. Therefore, a set of questions may assess students' ability to integrate several general learner expectations (GLEs). All questions will measure achievement of scientific knowledge; some will also measure achievement of skills and /or STS connections.

Examination Design

The design of the 1997 Chemistry 30 diploma examinations is as follows:

Question Format	*Number of Questions*	*Percent Emphasis*
Multiple Choice	44	55
Numerical Response	12	15
Written Response	2	30

The machine-scored portion of each examination contains both multiple-choice and numerical-response questions, some of which may be linked together.

Multiple-choice questions are of two types: *discrete* and *context-dependent*. A discrete question stands on its own without any additional directions or information. It may take the form of a question or an incomplete statement. A context-dependent question provides information separate from the question stem. Most of the multiple-choice questions are *context-dependent*.

A particular context may be used for more than one multiple-choice question, one or more numerical-response questions, as well as for one written-response question.

Answers for multiple-choice questions are recorded in the first section of the machine-scored answer sheet, and answers for numerical-response questions are recorded in the second section on the same side of the same machine-scored answer sheet. Answers to the written-response questions are written right in the exam booklet.

Numerical-response questions are of three types: calculation of numerical values, selection of numbered events or structures from a list, and determination of a sequence of events.

Linked questions are those questions whose correct answer depends upon the answer to the preceding question. These questions will be scored based upon the correct manipulation of the previous answer, thus it will be possible to receive marks for a question even though the preceeding question was answered incorrectly.

The written-response portion of each Chemistry 30 diploma examination contains two questions: an analytically-scored question and a holistically-scored question. Each question has a value of 15 percent.

Emphases in the 1997 Examinations

NEW

- Students are expected to solve machine-scored questions that relate directly to the nature of STS connections.

NEW

- Students are expected to be able to perform calculations using the Ideal Gas Law.
- Students are expected to be able to determine the meaning of potentially unfamiliar words from the context in which they are used. For example, electrowinning, sacrificial anode, and cathodic protection are all terms that refer to electolytic systems.
- Students are expected to be able to write balanced net ionic equations for chemical reactions.

CLARIFICATION

- Students are **not** expected to be able to predict whether or not a reaction is quantative. However, this is not meant to discourage the teaching of this concept. Students should be able to recognize when a reaction is quantitative from information provided to them.
- Students are expected to know that $K_a \times K_b = K_w$.
- Students are expected to be able to solve linked questions.
- We will continue to evaluate written-response questions on how well the answer is communicated.
- Some questions will include concepts from more than one of the units.
- Written-response questions will require students to see relationships among concepts learned and require students to supply appropriate contexts.
- Some questions will require students to apply what they have learned to new contexts.
- Written-response questions may require students to write balanced chemical equations including correct states of matter.
- Students are expected to devise a balanced half-reaction in acid or neutral solution. They will be expected to balance chemical equations that occur in basic environments, but not by devising their own half-reactions.
- Students are expected to balance an auto-oxidation (disproportionation) reaction given the reagents involved.

CLARIFICATION

- Numerical answers are to be rounded only once, at the end of the question. Intermediate numbers are to be used as displayed on the student's calculator. For linked questions, answers are to be rounded at the end of each question. Thus, the values used in the linked question should be the rounded value, since linked questions are **not one** question but a series of independent items.

- Students are expected to use the appropriate SI notations in their responses. A list of these symbols can be found in the new data booklet.
- Students will **not** be expected to solve questions utilizing $\Delta E_p = vc\Delta t$. This requires the use of density and implies that a volumetric measure, such as gas volumes, would be appropriate. The expansion of the curriculum through this interpretation is not appropriate or valid. This concept is also flawed, in that specific heat capacity is a measure based only on mass and hence "vc" has no meaning. Additionally, the use of volume is problematic in that volume is temperature dependent, like "c."
- The diploma examination treats the terms "oxidation number" and "oxidation state" as synonyms. Students are expected to assign oxidation numbers to hydrides and peroxides.
- The diploma examination will define "electrochemical cells" as either Voltaic cells or electrolytic cells. The term galvanic will not be used on the diploma examination.
- Students will **not** be expected to solve questions utilizing the quadratic equation. However, it is expected that the student set up the relationship correctly and that only when the mathematical operation is to take place is a statement about approximation to be made and used. However, this is not meant to discourage the teaching of this concept. Furthermore, a student will be expected to use a quadratic equation to solve a question in the written-response section of the examination **if** the student selects an acid to an open-ended question that an approximation cannot be made for. No student will be penalized on any portion of the examination for using the quadratic equation to solve a problem.

NEW

- Students are expected to determine the pH at the equivalence-point of a reaction, and at different volumes after the equivalence point has been reached.

NEW

- The use of approximation to solve equilibrium expressions is only acceptable when the solving of the question results in a quadratic expression and the original concentration of the acid or base is one thousand fold greater than the K_a or K_b.

CLARIFICATION

- Students are expected to be as familiar with calculations involving K_b as they are for K_a.
- Students are expected to know that the term amphiprotic is a synonym for amphoteric, thus either term may be used on diploma examinations.

  - The diploma examination will treat the terms *equivalence-point* and *end-point* as follows:

    > Equivalence-point is the point at which chemically equivalent amounts have been added. Thus a "diploma-type question" may ask students to *indicate on the graph where the equivalence-point for the reaction occurs.* The rationale for this is that the question is about completion of the reaction. The term end-point really has no meaning unless it is within a context; for example,
    >
    > *. . . 40.2 mL was used to titrate the sample to the green bromothymol blue (indicator) end-point.*

  - The diploma examination will treat the terms precision, readability, and accuracy in the following manner, as defined by IUPAC:

    > Precision refers to the reproducibility of measurements and **not** to "the place value of the last digit obtained in a measurement." The last place value of a measurement is the readability of the balance/measuring instrument. The term accuracy refers to the difference between a result and the true value.

- Students will **not** be expected to solve questions using percent reaction. However, students are expected to be able to determine the percent reaction of any reaction.

- In past examinations, a number of terms used in the context of scientific process skill questions have confused some students. A sample of such terms with their preferred definitions follows.

  > Hypothesis is a single proposition intended as a possible explanation for an observed phenomenon; e.g., a possible cause for a specific effect.
  >
  > Conclusion is a proposition that summarizes the extent to which a hypothesis and/or a theory has been supported or contradicted by the evidence.
  >
  > Experiment is a set of manipulations and/or specific observations of nature that allow the testing of hypotheses and/or generalizations.

Variables are conditions that can change in an experiment. Variables in experiments are categorized as:

manipulated variables (independent variables)—conditions that were deliberately changed by the experimenter

controlled variables (fixed or restrained variables)—conditions that could have changed but did not, because of the intervention of the experimenter

responding variables (dependent variables)—conditions that changed in response to the change in the manipulated variables

- Students are advised to review the meaning of directing words as defined in Appendix C. These words will be used in the instructions given for responding to most items in the examinations, particularly in the written-response section.

Soft-Linked Question Format Information

This format refers to a group of questions that rely on information from the preceding question to arrive at an answer. In all cases, the preceding question need not be answered correctly for students to receive marks for the question. All that is required is for the student to correctly use the value recorded or selected in the previous question to receive marks for the question. The preceding question could be either a multiple-choice question or a numerical-response question. In the case of a multiple-choice question, the student should use the selected value rather than any value that may have been determined. This means that the potentially unrounded value displayed in a calculator is not used. In the case of a numerical-response question, the value used must be the same as the value recorded.

The number of soft-linked items will not exceed four in any single series. In addition, the normal linking will be either a multiple-choice or numerical-response item linked to a numerical-response item; however, multiple-choice or numerical-response items may be linked to multiple-choice item(s).

Sample Test Items

These items have been selected to illustrate clarifications and new emphases in the 1997 examinations.

Students should be able to perform questions like this using K_a, hence they should also be able to solve this question. The major problem is the application of the "approximation" in situations where it is clearly inappropriate.

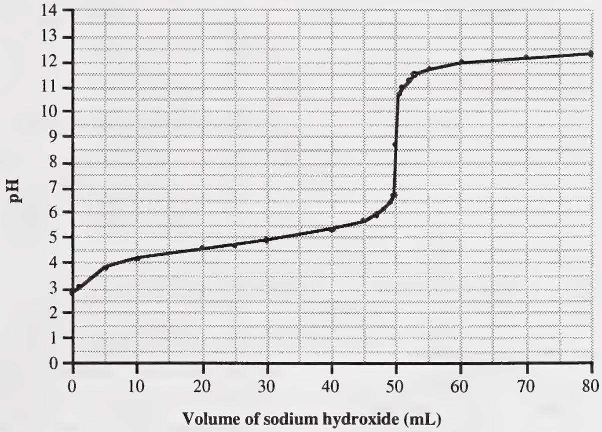
1. If a 0.150 mol/L solution of hydrazine, NH, has a pH = 10.70, what is the value of K_b for $N_2H_{4(aq)} + H_2O_{(l)} \rightleftharpoons N_2H_5{}^+{}_{(aq)} + OH^-{}_{(aq)}$?

•A. 1.7×10^{-6} mol/L
B. 2.0×10^{-11} mol/L
C. 5.0×10^{-4} mol/L
D. 2.5×10^{-7} mol/L

Students should be able to distinguish between the terms "end point" and "equivalence point."

Use the following information to answer the next question.

A dilute acid solution was titrated with 0.10 mol/L $NaOH_{(aq)}$. The following titration curve was obtained.



2. The same acid was titrated with 0.10 mol/L $NaOH_{(aq)}$ using indigo carmine indicator. A student correctly predicted that the volume of $NaOH_{(aq)}$ required for this titration would be

A. less because the equivalence-point occurs after the visual endpoint

B. greater because the equivalence-point occurs after the visual endpoint

C. less because the end-point occurs after the equivalence point

•D. greater because the end-point occurs after the equivalence point

If students use an approximation, they will arrive at the incorrect answer D rather than the correct value C.

3. The trace amounts of sulphur dioxide produced in the firing of brick, if released into the air, can react with water in the atmosphere to produce sulphurous acid. The concentration of sulphurous acid required to produce a solution of pH 5.62 is

A. 2.3×10^{9} mol/L
B. 5.4×10^{3} mol/L
•C. 2.4×10^{-6} mol/L
D. 4.4×10^{-10} mol/L

Students should be able to identify the STS perspectives.

4. Which statement is **not** correctly labelled?

A. Altering the operating temperature of a furnace is a method of controlling the amounts of toxic emissions. (technological)

•B. Knowledge of the role of oxygen molecules in combustion reactions was essential to early smelting operations. (technological)

C. Ernest Solvay's soda ash production process used relatively inexpensive raw materials easily accessible from limestone cliffs and salt water. (economic)

D. A government decision to ignore high levels of pollution downstream from a city had little public support. (environmental)

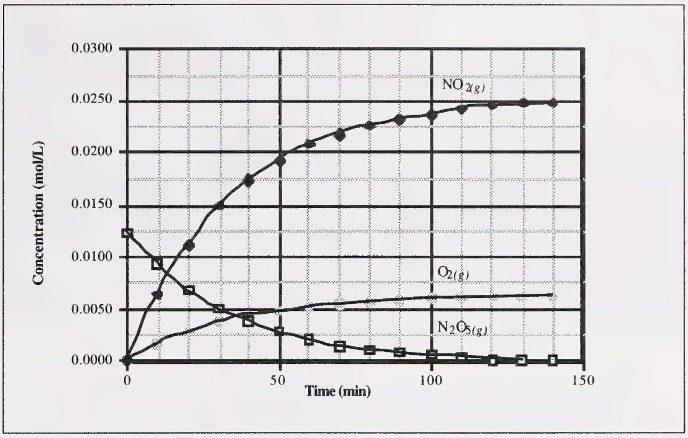
This should be a straightforward calculation that all students should be able to perform successfully. Lack of success on questions like this can be traced back to the use of approximations to avoid solving quadratic expressions.

5. The equilibrium $4H_{2(g)} + N_2O_{4(g)} \rightleftharpoons N_{2(g)} + 4H_2O_{(g)}$ was investigated. Initially, 1.60 mol of $H_{2(g)}$ and 1.00 mol of $N_2O_{4(g)}$ were injected into a 1.00 L vessel. When equilibrium was established, the concentration of $H_{2(g)}$ was 1.20 mol/L. The equilibrium constant for the reaction was

•A. 1.37×10^{-3}
B. 7.29×10^{2}
C. 3.70×10^{-2}
D. 2.50×10^{-2}

Students should recognize that this is not an equilibrium because the concentration of the reactant(s) is zero.

Use the following information to answer the next question.



6. Based on this graph, a logical conclusion is that the decomposition of $N_2O_{5(g)}$ into $O_{2(g)}$ and $NO_{2(g)}$ is

A. an equilibrium reaction, with the products favoured

B. en equilibrium reaction, with the reactants favoured

•C. a quantitative reaction

D. a non-spontaneous reaction

Assessment of Skills and STS Connections

Students' understanding of the concepts of science are measured by every question on the examinations. In addition, some questions measure the students' development of the skills and thinking processes associated with scientific inquiry. Some questions will measure students' understanding of the interrelationships between science and technology and among science, technology, and society.

Students are advised that no one viewpoint will be considered more worthy of serious consideration than another in response to an open-ended question. However, in machine-scored questions, one viewpoint will be viewed as correct. Holistic scoring of "issues" and "decision-making" questions will be guided by the following principles:

- the problem-solving process should be organized, rigorous, and intellectually sound; that is, the process should not be limited to emotional assertions and uninformed opinions
- analyses of moral dilemmas should focus on the **goals**, **rights**, and **duties** of the participating groups
- all credible arguments should meet two standards:
  - valid conclusions must follow from the reasons by accepted rules of logic
  - all reasons must count as good reasons for everyone

Communication skills are assessed most directly in the teacher-scored questions. For the open-response questions, the descriptions used in the minor holistic scoring guides include criteria for assessing conventions of a variety of communication skills.

The term *communication skills* includes those processes by which information is exchanged through appropriate conventions. These conventions include:

- words, sentences, paragraphs
- graphs, diagrams
- mathematical and chemical formulas, mathematical and chemical equations
- significant digits, units of measurement

Conventions that are considered appropriate for a particular response are subject- and question-specific.

Appendix A

Calculator Policy

POLICY: USE OF CALCULATORS ON ALBERTA EDUCATION DIPLOMA EXAMINATIONS

Background

The knowledge, skills, and attitudes relevant to technology and its uses are being incorporated into courses and programs of study wherever appropriate. Students are expected to learn the advantages and limitations of technological developments and their impact upon society. The ability to use technology helps students understand and appreciate the process of technological change, gives added depth to programs, and provides the basis for the development of skills and understanding. These expectations are reflected in the diploma examinations. Since the data provided for writing diploma examinations in mathematics and the sciences do not include information such as logarithms and trigonometric functions, students will need to use scientific calculators for these exams.

Definition

This policy considers a scientific calculator to be a hand-held device designed primarily for mathematical computations. Included in this definition are those scientific calculators having graphing capabilities, built-in formulas, mathematical functions, or other programmable features.

Policy

To ensure compatibility with provincial *Programs of Study* and equity and fairness for all students, Alberta Education expects students to use scientific calculators, as defined above, when they are writing diploma examinations in mathematics and the sciences. Examinations are constructed to ensure that the use of particular models of calculators neither advantages nor disadvantages individual students.

Procedures

1. Teachers must, at the beginning of a course, advise students of the types of calculators that they may use when writing diploma examinations in mathematics and the sciences. Teachers must also advise students of the types of information that can be stored in calculators that are brought into diploma examinations. Calculators that have built-in notes (definitions or explanations in alpha notation) that cannot be cleared are not permitted.

2. Students must clear calculators that are brought into diploma examinations of all information they have stored except for
   a. programs used for computing values of the formulas on the diploma examination data tear-out pages or in the data booklets,
   b. programs used for graphing quadratic relations as found in the Mathematics 30/33 Interim Teacher Resource Manual.

3. Students must not bring external devices to support calculators into the exam. Such devices include manuals, printed or electronic cards, printers, memory expansion chips or cards, external keyboards, or any annotations outlining operational procedures for scientific calculators.

4. In preparation for calculator failure, students may bring extra calculators and batteries into the exam room.

5. During exams, supervising teachers must ensure that
   a. all calculators operate in silent mode,
   b. students do not share calculators or information contained within them,
   c. calculator cases are stored on the floor throughout the exam, and
   d. all examination rules are followed.

6. If you have any questions or comments about the implementation of this policy, please contact the Math/Science Unit, Student Evaluation Branch, at 403-427-0010 or FAX 403-422-4200.

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Alberta
EDUCATION

Revised 30 August 96

Appendix B

Guidelines for Significant Digits, Manipulation of Data, and Rounding in the Sciences Diploma Examinations

Significant Digits (measured values)

1. For all non-logarithmic values, regardless of decimal position, any of the digits 1 to 9 is a significant digit; 0 may be significant. For example:

   123 0.123 0.00230 2.30×10^3
   all have 3 significant digits

2. Leading zeros are not significant. For example:

   0.12 and 0.012 each have two significant digits

3. Trailing zeros to the right of the decimal are significant. For example:

   0.123 00 and 20.000 each have five significant digits

4. Zeros to the right of a whole number are considered to be ambiguous. **The Student Evaluation Branch considers all trailing zeros to be significant**. For example:

   200 has three significant digits

5. For logarithmic values, such as pH, any digit to the left of the decimal is **not** significant. For example:

   a pH of 1.23 has two significant digits
   a pH of 7 has no significant digits

Manipulation of Data

1. When adding or subtracting measured quantities, the calculated answer should be rounded to the same degree of precision as that of the least precise number used in the computation **if this is the only operation**. For example:

   12.3 (least precise)
   0.12
   12.34
   24.76

   The answer should be rounded to 24.8.

2. When multiplying or dividing measured quantities, the calculated answer should be rounded to the same number of significant digits as are contained in the quantity with the fewest number of significant digits **if this is the only operation**. For example:

   (1.23)(54.321) = 66.81483

   The answer should be rounded to 66.8.

3. When a series of calculations is performed, each interim value should not be rounded before carrying out the next calculation. The final answer should then be rounded to the same number of significant digits as are contained in the quantity in the original data with the fewest number of significant digits. For example:

   In determining the value of (1.23)(4.321)/(3.45 – 3.21), three calculations are required:

   a. 3.45 – 3.21 = 0.24

   b. (1.23)(4.321) = 5.31483

   c. 5.31483/0.24 = 22.145125

      [Not 5.31/0.24 = 22.125]

   The value should be rounded to 22.1.

   Note: In the example given, steps *a* and *b* yield interim values. These values should not be used in determining the number of significant digits.

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4. When calculations involve exact numbers (counted and defined values) the calculated answer should be rounded based upon the measured value(s). For example:

   12 eggs × 52.3 g/egg = 628 g

Rounding

1. When the first digit to be dropped is less than or equal to 4, the last digit retained should not be changed. For example:

   1.2345 rounded to three digits is 1.23

2. When the first digit to be dropped is greater than or equal to 5, the last digit retained should be increased by one. For example:

   12.25 rounded to three digits is 12.3

Appendix C

Directing Words

Discuss

The word “discuss” will not be used as a directing word on math and science diploma examinations because it is not used consistently to mean a single activity

The following words are specific in meaning.

Compare

Examine the character or qualities of two things by providing characteristics of both that point out their mutual *similarities* and *differences*

Conclude

State a logical end based on reasoning and/or evidence

Contrast/Distinguish

Point out the *differences* between two things that have similar or comparable natures

Criticize

Point out the *merits* and *demerits* of an item or issue

Define

Provide the essential qualities or meaning of a word or concept; make distinct and clear by marking out the limits

Describe

Give a written account or represent the characteristics of something by a figure, model, or picture

Design/Plan

Construct a plan, i.e., a detailed sequence of actions, for a specific purpose

Enumerate

Specify one by one or list in concise form and according to some order

Evaluate

Give the significance or worth of something by identifying the good and bad points or the advantages and disadvantages

Explain

Make clear what is not immediately obvious or entirely known; give the cause of or reason for; make known in detail

How

Show in what manner or way, with what meaning

Hypothesize

Form a tentative proposition intended as a possible explanation for an observed phenomenon; i.e., a possible cause for a specific effect. The proposition should be testable logically and/or empirically

Identify

Recognize and select as having the characteristics of something

Illustrate

Make clear by giving an example. The form of the example must be specified in the question; i.e., word description, sketch, or diagram

Infer

Form a generalization from sample data; arrive at a conclusion by reasoning from evidence

Interpret

Tell the meaning of something, present information in a new form that adds meaning to the original data

Justify/Show How

Show reasons for or give facts that support a position

Outline

Give, in an organized fashion, the essential parts of something. The form of the outline must be specified in the question; i.e., lists, flow charts, concept maps

Predict

Tell in advance on the basis of empirical evidence and/or logic

Prove

Establish the truth, validity, or genuineness of something by giving factual evidence or logical reasons

Relate

Show logical or causal connection between things

Solve

Give a solution for a problem; i.e., explanation in words and/or numbers

Summarize

Give a brief account of the main points

Trace

Give a step-by-step description of the development

Why

Show the cause, reason, or purpose

Appendix D

Alternative Blueprint Format

Knowledge **Emphasis – 100%**

The student can:

<table>
<tr>
<td colspan="2">• apply conservation of matter and energy to changing systems; use evidence and knowledge to predict outcomes in a broad range of reactions (GLE 1)

30 – 40%
(Units 1, 2, & 3)</td>
<td colspan="2">• analyze and evaluate physical, chemical, and biological systems in terms of energy, matter forms, transfers, movement, and conservation (GLE 2)

60 – 70%
(Units 1, 2, & 3)</td>
</tr>
<tr>
<td rowspan="2">• explain the relationship in physical, chemical, and nuclear changes through the rearrangement of bonds and the resulting release or absorption of energy (GLE 3)

28 – 32%
(Unit 1)</td>
<td rowspan="2">• quantitatively and qualitatively explain and analyze the transfer of electrons and the associated transformations that take place in electrochemical systems (GLE 4)

30 – 34%
(Unit 2)</td>
<td>• quantitatively and qualitatively describe equilibrium systems for acids, bases, and gases and some of their applications (GLE 5)

16 – 22%</td>
<td>• quantitatively and qualitatively describe acids and bases in physical and conceptual terms (Brønsted-Lowry) (GLE 6)

16 – 22%</td>
</tr>
<tr>
<td colspan="2">36 – 40%
(Unit 3)</td>
</tr>
<tr>
<td colspan="2">Skills (GLE 1 – 6)
• design, interpret, explain, analyze, and evaluate investigations
• organize data into tables, graphs, and diagrams and predict relationships
• interpret, explain, analyze, and evaluate data to infer relationships
• use appropriate scientific terminology and mathematical language to communicate and explain scientific concepts

40 – 60%
(Units 1, 2, & 3)</td>
<td colspan="2">Connections Among Science, Technology, and Society (GLE 1 – 6)
• apply cause and effect reasoning to formulate relationships in which scientific evidence shapes or refutes a theory; explain the limitations of science and technology in answering all questions and solving all problems
• describe and evaluate the design and function of technological solutions to theoretical and practical problems; relate the ways in which science and technology advance one another
• evaluate from a variety of perspectives how science and technology are influenced and supported by society; assess the ability to interact responsibly with the environment
• apply the skills and knowledge acquired in science to everyday life

40 – 60%
(Units 1, 2, & 3)</td>
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